

# BE-FAST (Balance, Eyes, Face, Arm, Speech, Time) Reducing the Proportion of Strokes Missed Using the FAST Mnemonic

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**Background and Purpose**—The FAST algorithm (Face, Arm, Speech, Time) helps identify persons having an acute stroke. We determined the proportion of patients with acute ischemic stroke not captured by FAST and evaluated a revised mnemonic.

**Methods**—Records of all patients admitted to the University of Kentucky Stroke Center between January and December 2014 with a discharge *International Classification of Diseases, Ninth Revision, Clinical Modification* code for acute ischemic stroke were reviewed. Those misclassified, having missing National Institutes of Health Stroke Scale data, or were comatose or intubated were excluded. Presenting symptoms, demographics, and examination findings based on the National Institutes of Health Stroke Scale data were abstracted.

**Results**—Of 858 consecutive records identified, 736 met inclusion criteria; 14.1% did not have any FAST symptoms at presentation. Of these, 42% had gait imbalance or leg weakness, 40% visual symptoms, and 70% either symptom. With their addition, the proportion of stroke patients not identified was reduced to 4.4% ( $P<0.0001$ ). In a sensitivity analysis, if face weakness, arm weakness, or speech impairment on admission examination were considered in addition to a history of FAST symptoms, the proportion missed was reduced to 9.9% ( $P=0.0010$ ). The proportion of stroke patients not identified was also reduced (2.6%) with the addition of a history of gait imbalance/leg weakness or visual symptoms ( $P<0.0001$ ).

**Conclusions**—Of patients with ischemic stroke with deficits potentially amenable to acute intervention, 14% are not identified using FAST. The inclusion of gait/leg and visual symptoms leads to a reduction in missed strokes. If validated in a prospective study, a revision of public educational programs may be warranted. (*Stroke*. 2017;48:479-481. DOI: 10.1161/STROKEAHA.116.015169.)

**Key Words:** arm ■ ataxia ■ diagnosis ■ emergency ■ stroke

The benefit of the administration of intravenous tissue-type plasminogen activator or endovascular clot retrieval in patients with acute ischemic stroke decreases as the time between symptom onset and treatment increases.<sup>1,2</sup> Public knowledge of stroke symptoms, however, is generally poor.<sup>3</sup> Although several screening tools have been developed to help the public identify persons having an acute stroke to facilitate their rapid access to medical care, the FAST mnemonic (Face, Arm, Speech, Time) has been adopted by the American Heart Association and is one of the most commonly publicized.<sup>4</sup> An initial study found that FAST has an 88% sensitivity for the identification of carotid artery distribution strokes with 77% of those without FAST symptoms having strokes in the vertebrobasilar distribution.<sup>4</sup> Subsequent work found that FAST identified 69% to 90% of strokes but missed up to 40% of those with posterior circulation events.<sup>5-7</sup> Rates improved with the addition of visual symptoms and limb ataxia, but ataxia can be difficult to identify.<sup>6</sup> Some educational programs have used the mnemonic BE-FAST, adding a “B” for balance and

an “E” for eyes, but supportive data are limited. We sought to determine the current proportion of acute ischemic stroke patients with symptoms not captured by FAST and whether the addition of gait-related or visual symptoms would improve detection rates.

## Methods

The records of all patients admitted to the University of Kentucky Stroke Center between January and December 2014 with a discharge diagnosis of acute ischemic stroke (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.00, 434.01, 434.11, and 434.91) were reviewed. Those misclassified, having missing National Institutes of Health Stroke Scale (NIHSS) data, or were comatose or intubated were excluded. Presenting symptoms, demographics, and examination findings based on the NIHSS were abstracted.<sup>8</sup>

The proportion of patients who did not have complaints of FAST symptoms recorded in their medical records and their other presenting symptoms were tabulated. In a sensitivity analysis, face weakness, arm weakness, or speech impairment on the admission NIHSS examination were considered in addition to a history of FAST

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**Table. Patient Characteristics by Group**

	Screen Positive	Screen Negative	P Value
<b>FAST</b>	<b>N=632</b>	<b>N=104</b>	
Mean age (SEM), y	65.7±0.6	63.5±1.3	0.066
Sex (% women)	48	44	0.525
Mean NIHSS	6.9±0.3	2.5±0.3	<0.0001
Median NIHSS	5	2	<0.001
<b>BE-FAST</b>	<b>N=704</b>	<b>N=32</b>	
Mean age (SEM), y	65.5±0.5	61.7±2.1	0.069
Sex (% women)	47	50	0.857
Mean NIHSS	6.5±0.2	2.4±0.6	<0.0001
Median NIHSS	4	1	<0.0001
<b>FAST or examination</b>	<b>N=663</b>	<b>N=73</b>	
Mean age (SEM), y	65.6±0.6	62.9±1.6	0.051
Sex (% women)	48	44	0.538
Mean NIHSS	6.9±0.3	1.2±0.1	<0.0001
Median NIHSS	5	1	<0.0001
<b>BE-FAST or examination</b>	<b>N=717</b>	<b>N=19</b>	
Mean age (SEM), y	65.5±0.5	59.8±2.9	0.035
Sex (% women)	48	42	0.630
Mean NIHSS	6.5±0.2	0.6±0.2	<0.0001
Median NIHSS	4	0	<0.0001

BE-FAST indicates Balance, Eyes, Face, Arm, Speech, Time; and NIHSS, National Institutes of Health Stroke Scale.

symptoms. The proportions of patients missed based on FAST was compared with the proportion missed after inclusion of gait-related (gait imbalance or lower extremity weakness) or visual (visual loss and diplopia) symptoms (ie, balance/leg weakness [B] and vision, eyes [E]; BE-FAST). The vascular distributions of strokes missed on FAST was determined based on review of magnetic resonance imaging brain reports.

Continuous variables were compared with a *t* test, ordinal data with a Mann–Whitney *U* test, categorical variables with a  $\chi^2$  test, and proportions with a *z* test. Statistical tests were 2 sided with *P*<0.05 considered statistically significant and *P*=0.05 to 0.10 indicative of a statistical trend. Statistical analysis was performed using JMP software (SAS Institute, Cary, NC) and MedCalc (MedCalc Software bvba, Ostend, Belgium).

## Results

Of 858 records reviewed based on *International Classification of Diseases, Ninth Revision, Clinical Modification* codes, 736 patients admitted with an acute ischemic stroke were included in the analysis (50 were incorrectly classified as having an acute stroke, 28 were excluded because of missing NIHSS data, and 44 were intubated or comatose). Of the 736 included patients, 104 patients (14.1%) did not have FAST symptoms at presentation. Compared with those who had at least one FAST symptom, those without FAST symptoms did not differ by sex but tended to be younger (*P*=0.066) and had less severe neurological impairments based on the NIHSS score (*P*<0.0001; Table). Of those patients who were FAST symptom negative, the most common presenting symptoms were

gait imbalance (33%)/leg weakness (10%), visual impairment (visual loss, diplopia, or blurring; 40%), headache (16%), and dizziness (8%); 70% of these patients had symptoms of either a gait abnormality/leg weakness or a visual impairment (either alone [29%] or in combination with other non-FAST symptoms). The 14.1% of stroke patients who would not have been identified by FAST alone was reduced to 4.4% with the addition of these 2 symptoms (BE-FAST; *z*=7.62; 95% confidence interval, 2.99–6.098; *P*<0.0001). Compared with those who were BE-FAST symptom positive, those without any of these symptoms did not differ by sex but also tended to be younger (*P*=0.069) and had less severe neurological impairments based on the NIHSS score (Table). On review of magnetic resonance imaging reports, 71% of strokes missed by FAST involved the vertebrobasilar territory with 64% restricted to this distribution. The proportion missed that were limited to the vertebrobasilar circulation was reduced to 43% with BE-FAST (*P*=0.042).

In a sensitivity analysis, if face weakness, arm weakness, or speech impairment on the admission NIHSS examination were considered in addition to a documented history of FAST symptoms, the proportion of stroke patients who would be missed was reduced from 14.1% to 9.9% (*z*=3.29; 95% confidence interval, 7.9–12.3; *P*=0.0010); 68% of these missed strokes were restricted to the vertebrobasilar circulation. Compared with those who were FAST symptom or examination positive, those without any of these symptoms or

findings did not differ by sex but again tended to be younger ( $P=0.0511$ ) and have less severe neurological impairments based on the NIHSS score (Table). Of those who were FAST symptom and examination negative, the proportion of stroke patients who would not have been identified was reduced with the addition of a history of gait imbalance/leg weakness or visual impairment (BE-FAST, 2.5%;  $z=6.66$ ; 95% confidence interval, 1.56–4.00;  $P<0.0001$ ). Compared with those who were BE-FAST symptom or examination positive, those without any of these symptoms or findings did not differ by sex but were younger and had less severe neurological impairments based on the NIHSS score (Table). A trend suggested a reduction in strokes missed restricted to the vertebrobasilar circulation among those who were BE-FAST symptom or examination positive (47%;  $P=0.11$ ).

### Discussion

We found that 14% of patients with acute stroke would be missed using FAST alone, and this proportion was reduced to 4.4% with addition of a history of gait and visual symptoms (BE-FAST). Consistent with previous reports, the majority of strokes (71%) missed using FAST involved the vertebrobasilar circulation.<sup>4,6,7</sup> Although more extensive symptom recognition tools such as Give Me 5 for Stroke (Walk, is balance off?; Talk, is speech slurred or face droopy?; Reach, is one side weak or numb?; See, is vision all or partly lost?; Feel—is there a severe headache?) can identify more strokes than FAST (99.9% versus 88.9%), they are more difficult to remember.<sup>5,9</sup> A simple modification of the FAST mnemonic (BE-FAST) could reduce the proportion of missed strokes while reinforcing the essential public health message.

Although there was no difference based on sex, those with strokes missed by FAST tended to be younger and had less severe deficits than those identified by FAST. The gait impairment or visual loss identified with BE-FAST can, however, lead to important disabilities that may be appropriate for acute intervention.<sup>10</sup>

The primary limitation of this study is its retrospective design. All relevant patient symptoms may not have been recorded in the medical record. A sensitivity analysis in which findings on initial examination were considered in addition to historic symptoms, however, did not substantially alter the results. Because the sample was limited to patients with a

confirmed stroke, it was not possible to calculate the specificity of BE-FAST. Because the study was performed at a single tertiary care center, the proportion of strokes missed may be different in other settings.

BE-FAST could capture >95% of ischemic strokes. If validated in a prospective study, a revision of public educational programs may be warranted.

### Disclosures

None.

### References

- Emberson J, Lees KR, Lyden P, Blackwell L, Albers G, Bluhmki E, et al; Stroke Thrombolysis Trialists' Collaborative Group. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. *Lancet*. 2014;384:1929–1935. doi: 10.1016/S0140-6736(14)60584-5.
- Prabhakaran S, Ruff I, Bernstein RA. Acute stroke intervention: a systematic review. *JAMA*. 2015;313:1451–1462. doi: 10.1001/jama.2015.3058.
- Fang J, Keenan NL, Ayla C, Dai S, Merritt R, Denny CH. Awareness of stroke warning symptoms - 13 states and the District of Columbia, 2005. *Morb Mortal Wkly Rep*. 2008;57:481–485.
- Kothari RU, Pancioli A, Liu T, Brott T, Broderick J. Cincinnati Prehospital Stroke Scale: reproducibility and validity. *Ann Emerg Med*. 1999;33:373–378.
- Kleindorfer DO, Miller R, Moomaw CJ, Alwell K, Broderick JP, Khoury J, et al. Designing a message for public education regarding stroke: does FAST capture enough stroke? *Stroke*. 2007;38:2864–2868. doi: 10.1161/STROKEAHA.107.484329.
- Gulli G, Markus HS. The use of FAST and ABCD2 scores in posterior circulation, compared with anterior circulation, stroke and transient ischemic attack. *J Neurol Neurosurg Psychiatry*. 2012;83:228–229. doi: 10.1136/jnnp.2010.222091.
- Huwez F, Casswell EJ. FAST-AV or FAST-AB tool improves the sensitivity of FAST screening for detection of posterior circulation strokes. *Int J Stroke*. 2013;8:E3. doi: 10.1111/ijss.12008.
- Brott T, Adams HP Jr, Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: a clinical examination scale. *Stroke*. 1989;20:864–870.
- “Give me 5” campaign to help public identify signs of stroke. 2008. [http://patients.aan.com/news/?event=read&article\\_id=4127](http://patients.aan.com/news/?event=read&article_id=4127). Accessed August 24, 2016.
- Demaerschalk BM, Kleindorfer DO, Adeoye OM, Demchuk AM, Fugate JE, Grotta JC, et al; American Heart Association Stroke Council and Council on Epidemiology and Prevention. Scientific rationale for the inclusion and exclusion criteria for intravenous alteplase in acute ischemic stroke: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2016;47:581–641. doi: 10.1161/STR.0000000000000086.